MURRAY COD, *MACCULLOCHELLA MACQUARIENSIS*, IN WESTERN AUSTRALIA

By N. M. MORRISSY, Department of Fisheries and Fauna, Perth.

INTRODUCTION

A number of species of freshwater fish were introduced into waters of the South-West of the state during the 1890's in the hope that they would provide fisheries of sporting or commercial value. The foreign species included trout *(Salmo trutta and S. gairdnerii)*, English Perch *(Perca fluviatilis)*, Carp *(Carassius carassius)* Tench *(Tinca tinca)*, and the Australian species were Murray Cod, Golden Perch *(Plectroplites ambignus)* and Victorian Silver Eels *(Anguilla australis)*. Carp and English Perch are the only species which are generally well known to have survived and multiplied from these introductions. However records of the Departments of Fisheries and Fauna, and of Agriculture, together with some local information collected lately, confirm the success of Murray Cod for a number of years in one locality and reasons for their later disappearance.

LOCATIONS OF LIBERATION OF MURRAY COD.

The importation of Murray Cod was organised by W. Saville-Kent acting in a professional capacity as Commissioner, Inspector of Fisheries, and Fisheries Expert Reporter to the State Government. In 1894, several hundred young Murray Cod and Golden Perch, averaging a quarter to half a pound in weight, were taken, by train, from Morgan on the Murray River in South Australia to Adelaide and then shipped in batches by mail steamers to Albany (Saville-Kent, 1897). The majority of the fish were taken by train to the Upper Swan (or Avon) River, near York and Beverley, where they were liberated by Mr. (Capt.) F. Hare who was then Resident Magistrate of York and later Commissioner of Police. Saville-Kent states that the remainder of the fish were placed in a lake about ten miles from Albany (Fig. 1, Lake Grassmere, Elleker or Powell). This liberation may have been fortuitous and there is no distinct indication that it included Golden Perch and eels as well as cod. Mr. A. Shirley, who lives on the western side of the lake (as his father did), recollects the story that a train driver, Kennedy, and the Elleker postmaster, Hutchinson, released small fish on the northern perimeter of the lake near the railway

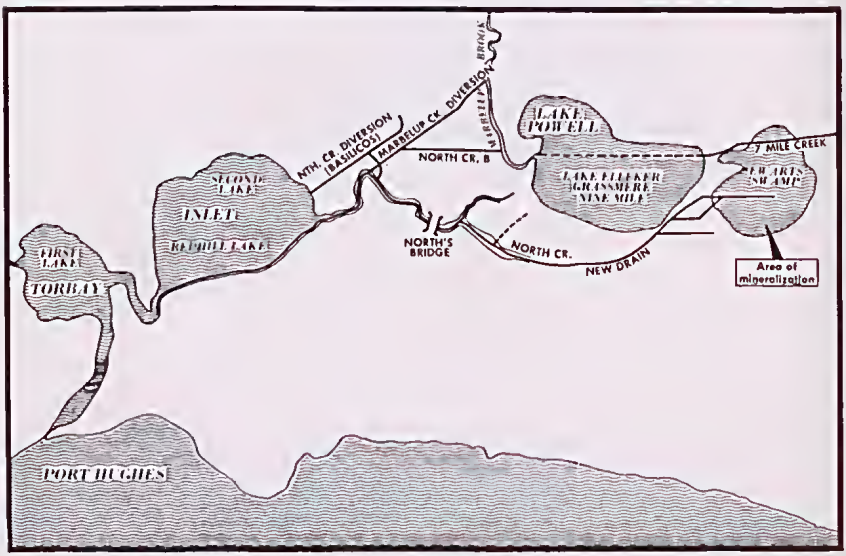

Fig. 1—Lake system in the Torbay area, west of Albany.

line using personal initiative after the fish were found abandoned at the railway station in Albany. F. Aldrich, writing in 1913 (as Chief Inspector of Fisheries) in the departmental file, thought that there had been perhaps two liberations of cod in the lake about 1892. One he attributed to Captain F. Hare, perhaps mistakenly since Hare was responsible for the Avon liberation, and the other (using information from an old settler, F. North, living adjacent to the lake) to the W.A. Land Co. in association with Major Young.

SUCCESS OF LIBERATION

In 1901 press publicity was given to the discovery of a dead cod of 21½ lb. in the Avon River ("York News," May 28; "Morning Herald," Perth, May 30; and the "West Australian," May 30). The fish was found floating in the Gwambygine Pool about 6 miles from York by a member of the Hicks family. Mr. C. F. Gale, the Chief Inspector of Fisheries, stated that the particular pool had been closed to fishing during the previous year because reports had been received by the department that many very young fish had been seen and occasionally large fish. Gale stated that Mr. F. Hare had released 45 fish (presumably cod), nearly 7in. in length and weighing a little over half a pound, in several pools in the district about five to six years previously. Later, in 1902, at a conference of fisheries delegates in Melbourne, Gale spoke of a fish of 41 lb., 39in. in length and 17in. in girth, which had died in the Avon and of sighting fish of three to four ounces and larger. Murray Perch were also stated to be "living and doing well." He described the Avon as an intermittent river, with pools of 50-60 ft. depth, that often ceased flowing for from one to two years.

No further records of sightings or catches of cod are available for the Avon River. Therefore, one cannot escape the impression that the success of the liberation in this river was judged too optimistically in 1901 from only two specimens of dead fish (the original fish stocked) and from observations of small fish which were not stated to have been positively identified as cod.

Information concerning the success of cod in Lake Grassmere is available from present day conversations with people living near the lake and from File 7/42 in the records of the Department of Fisheries and Fauna, W.A. Mr. A. Shirley, of Elleker, remarks that his father caught large cod on lines set from the bridge over the outlet creek from the lake. Mr. A. Basilico, of Torbay, came from Kojonup to market garden adjacent to the lake in 1912 and started fishing for cod in 1920. He set lines from springy saplings and often resorted to using groper lines because the cod, when hooked, would roll over and over until they broke the line. When fly ants were swarming he saw many large and small cod rising on summer evenings. The stomachs of the larger cod he captured contained "gilgies" (probably *Cherax preissi)* and small cod. The bigger cod were lethargic and he often stirred up the water along the banks before setting his lines. He caught cod of 40-50 lb. weight and sometimes up to 200 lb. of fish in a week. Both Shirley and Basilico recollect that when the lake eventually became polluted dead cod up to 70 lb. weight were seen around the shore. One of these cod was 6in. longer than a wheat bag. One old identity, Bill North, placed live cod in damp bags and railed them up to Perth Fish Market under the guise of sea groper. In November, 1913 a clipping from the "Southern Times" was affixed to the department file because it mentioned the capture of a fish from the lake which weighed 90 lb. A worker on the dam which was built in 1958 to divert the Marbellup Creek from flowing into the lake, caught a cod 4ft. in length.

It seems that the presence of cod in the lake was not widely spoken about during the early years of the century by the many market gardeners in the vicinity no doubt because of the ready accessibility to them of this excellent table fish.

The departmental file on Cod in Lake Grassmere commenced in 1913 when F. Aldrich was the Chief Inspector, and G. C. Linton the Albany Inspector of Fisheries. Linton reported on March 23, 1913 that W.

Hortin of Torbay had told him that fish from 2 to 50-60 lb. were seen dead in the outlet creek from the lake. Lately, he mentioned, a big drain had been cut into the lake linking it with a creek system arising a few hundred yards west of the lake and forming the outlet creek. The scheme had nearly drained the lake and fish, which he named as Murray Cod, that had sought deeper water toward the inlet were killed by sea-water. Aldrich immediately requested a specimen of the fish. Linton captured a fish on a line in the Marbellup Creek flowing into the lake and on April 1, 1913 it was received in Perth, identified, and mounted. From April 3, 1913 Aldrich visited the locality, sighting 15 dead fish of 4-60 lb. and reported to the Under Secretary on the situation and the value of the fishery. Samples of water taken by Aldrich were analysed for salt content (Table 1).

TABLE 1.—SALT CONTENT OF WATER SAMPLES COLLECTED BY F. ALDRICH IN APRIL, 1913 NEAR ALBANY.

Sample	Place	Salt (grains per gallon)
1	"Outlet Creek"	1031
2	Lake Grassmere	66
3	Lake Seppings (at Albany)	57

The high value (1.46%) for the salt content of the water sample from the outlet creek confirmed previous inferences as to the cause of death of the cod. Also a letter from Fred North, J.P., of Torbay Junction on April 21, 1913 mentions that Murray Cod of 10-12 lb. were being caught at the bridge over the Torbay Inlet after freshwater floods, a few days previously, had passed from the Lake, via the outlet creek, to the inlet lakes.

Further communication between Aldrich and Linton during October, 1913 relates that flood gates at the mouth of the Torbay Inlet were ineffective in keeping the water of the inlet fresh and that although the outlet creek and the second Torbay Lake were still fresh after the winter rains the first lake nearest the sea was salt. Aldrich tried subsequently to get a barrier placed across the outlet from Lake Grassmere, so as to prevent the loss of fish, but to no avail. On February 12, 1914 Linton reported that the outlet creek had stopped flowing although the water in it was still fresh (a water sample from North's Bridge showed a low salt content of 213 grains per gallon). There was also news of proposed sluice gates which would raise the water level in Lake Grassmere. On February 27, 1914 Linton found that the outlet creek was fresh water at North's Bridge and flowing again. By March 21, 1914, however, Fred North reported that dead fish had been found in Redhill Lake (the second Torbay Lake). Linton did not see any dead fish on April 3 but found that the Torbay Inlet Lakes were salty and very shallow while Lake Grassmere was fresh and deep. On April 20 Linton again failed to find dead fish but reported the capture of 17 and 40 lb. fish at North's Bridge where the waters were rising due to rain. Two years later on May 6, 1916 Linton found four dead fish of 4-7 lb. in the lower lakes which were salty while Lake Grassmere was very low but fresh. On June 27, 1916 Linton placed a net across the outlet creek to Lake Grassmere and despite, or because of, the strong flow captured about 100 small cod.

Very significantly, in retrospect, he mentions that with the winter floods in 1916 dead cod were found for the first time in Lake Grassmere. He saw about 20 dead fish of 5-35 lb. but none smaller. The local settlers thought that the cause of these deaths was "minerals." The dead fish were unusual in colour—a dark brown—and Linton emphasized on July 7 that the lake was full of very discoloured (dark brown) water. A sample of the water from the lake showed a very low salt content (11.55 grains per gallon). The sample had a very bad smell of sulphuretted hydrogen and Aldrich thought " . . . that, in all probability, foul drainage from the channel on the *eastern* side [of the lake] is chemically charged."

Linton captured two cod in the Marbellup Creek on December 16, 1927 and forwarded them to Perth. Both were females and the larger fish had almost completed spawning. The cod may still have persisted in the lake for on February 24, 1942 J. Goodlad the then Inspector of Albany

captured 27 small cod (?) in pools near the outlet creek. These were transferred to Lake Seppings at Albany upon advice from A. J. Fraser the new Chief Inspector. In addition on April 27, 1943 W. (Bill) North of Torbay was reported to have caught a cod at the top of the Torbay Lakes which weighed 33 lb. (gutted) and was sold for one shilling a pound.

Inspector J. Munro reported from Albany during September, 1946 that no cod had been seen in Lake Seppings. Frequent attempts by Munro and later K. Stathy to catch cod from Grassmere for transhipment to other waters were unsuccessful. Stathy reported in 1948 that the last cod, which he had mention of, was captured 2½ years previously and weighed 27 lb. although some may have been seen near the pumping station on the Marbellup Creek 15-18 months ago. Inspector D. Gordon in 1967 (personal communication) mentioned a report he had of the capture of a large cod in the Marbellup Creek.

The cod may have been unsuccessful in breeding in later years where they survived in the Marbellup Creek. Marron, *Cherax tenuimanus*, which are not indigenous to the Albany area, were introduced to the creek during the late '40's or early '50's so that they may have then preyed on the eggs of the cod.

POLLUTION OF LAKE GRASSMERE

The cause of the disappearance of Murray Cod from Lake Grassmere can be traced to pollution from agricultural land to the east of the lake. A comprehensive description of the development of the source of the pollution was found in an unpublished report of an investigation of the soils of the area in the period 1938-40; the work was most probably conducted by Dr. L. J. H. Teakle (File 913/37, Department of Agriculture, W.A.).

Apparently marcasite, a crystalline disulphide of iron, occurs in many swamp soils where the acidic solutions present usually contain iron and H_2S. Oxidation of the marcasite occurs near the surface of the soils when drainage is improved. This results in the formation of iron sulphate and sulphuric acid which by interaction with the soil lead to the formation of aluminium salts and gypsum. In 1940 it was reported that about 400 acres of erstwhile fertile vegetable land of the swamp type in the Cuthbert-Grassmere area had deteriorated on account of this type of mineralization and acidity. The latter had developed about 1915—particularly on Ewart's Swamp to the east of Lake Grassmere. Prior to 1913 about 70% of Ewart's Swamp was under cultivation and the water was quite potable. Shellfish and fish appeared to thrive not only on Ewart's Swamp but also in Lake Grassmere where Murray Cod were common according to the report. Prior to occupation of the area the waters of 7 Mile Creek, draining from the east into Lake Grassmere, flooded Ewart's Swamp but flood water was subsequently diverted from the swamp by a marginal drain. The water of 7 Mile Creek was of excellent quality. However about 1914 a drain, emptying into 7 Mile Creek, was deepened in order to improve the drainage of the Ewart Swamp area.

Examination of the water in this drain showed a pH of 2.68 and the water had the stringent taste of a solution rich in iron. This water was carried into Lake Grassmere by the 7 Mile Creek although, due to dilution, the waters of the lake were not found at that time to be highly acid by the investigator (pH 5.02). The report concluded that: "There is no doubt that the exposure of marcasite deposits to oxidation is the primary cause of the development of excessive acidity."

The pollution still exists in the drainage system of the area. The waters from areas east of Lake Grassmere are now largely carried to Torbay Inlet by a drain which skirts the southern perimeter of the lake. A water sample collected from this drain in February, 1969 had a pH of 3.4, 1.2 p.p.m. of iron in solution, 405 p.p.m. of sulphate, and a salinity of 17.68%. A sample from the outlet creek to Lake Grassmere, taken in November, 1968, had a pH of 3.0, ferrous iron was present, and the salinity was 11.7%.

DISCUSSION

Although Murray Cod appear to no longer exist in the Lake Grassmere environment there is ample evidence that the species survived and multiplied there for many years after liberation in the 1890's. The other liberation at the same time in the Avon River did not meet with such success. It is of some interest to examine the climates of the two areas of liberation since cod have been shown recently to require certain conditions for the stimulation of spawning. From the results of spawning experiments at Narrandera, N.S.W., Lake (1967) concluded that:—"*Maccullochella macquariensis* spawns at 20° C. provided there is a slight 'run off' of water into the pond, eggs are laid in hollow logs, or in similar situations." In their native habitat the melting snows of the Australian Alps in the spring cause river levels to rise. In South Australia the annual rise in flow of the Murray River may occur as late at February.

It is reasonable to assume that during the summer months the shallower waters of Lake Grassmere and the Avon River would heat up to 20° C. (68° F.). The provision of a rise in water level would seem less likely during the South-West summer when drought conditions usually prevail.

TABLE 2.—PERCENTAGE PROBABILITY OF RECEIVING SPECIFIED MONTHLY TOTALS

	November	December	January	February
Grassmere				
(1) ½in. or more	96	86	67	56
(2) 1in. or more	78	53	33	29
(3) 2in. or more	32	19	13	12
Beverley				
(1)	20	20	23	22
(2)	14	13	10	13
(3)	1	1	3	7

(Data from "Climatic Survey Region 11—Great Southern, W.A.", and "Climatological Survey Region 12—Albany, W.A.").

Table 2 shows that the probability of receiving heavy rainfalls during the warmer months of the year is considerably higher at Grassmere than at Beverley. At Grassmere at least an inch of rain falls, on the average, during December every two years and at least two inches every five years. For the highest rainfalls recorded in a single 24-hour period the meteorological summary for the Albany region reports: ". . . the greatest falls occur more frequently during the months January to April than at any other time of the year, and that the highest totals are generally recorded near the south coast."

ACKNOWLEDGEMENTS

Thanks are due to Inspector D. Gordon, formerly at Albany, for creating renewed interest in the cod at Grassmere and to Inspector K. Ostle at Albany for continuing the interest. Cadet Inspector J. Williams at Albany helped in obtaining the information on mineralization from the P.W.D. at Albany. Mr. G. H. Burvill, Assistant Director of the Department of Agriculture, gave permission for the use of the unpublished report on the soils of the Grassmere area. Mr. A. Basilico, of Torbay, and Mr. A. Shirley of Elleker, freely passed on useful recollections. Dr. D. L. Serventy provided additional helpful references.

REFERENCES

Climatic Survey Region 11—Great Southern Western Australia. Climatological Survey Region 12—Albany Western Australia (1962). Bureau of Meteorology, Commonwealth of Australia, Melbourne.

Investigations of the Cuthbert—Grassmere area, 1940; including, Notes on excessive acidity of certain W.A. soils. Departmental File 913/37 Department of Agriculture, Western Australia.

Fisheries—Cod—All species—General file. Departmental File 7/42. Department of Fisheries and Fauna, Western Australia.

Lake, J. S. 1967. Rearing experiments with five species of Australian Freshwater fishes. I. Inducement to spawning. *Aust. Jour. Mar. Freshw. Res.*, 18, (2): 137-53.

Murray Cod in Western Australia. Extract from the minutes of evidence and proceedings taken at conference of delegates from N.S.W., S.A., W.A. and Victoria, held at Melbourne, 30th May, 1902, p. 17.

Murray Cod at York. *West Australian,* 30.v.1901.
Murray Cod. *Morning Herald,* Perth. 30.v.1901.
Murray Cod. *York News.* 28.v.1901.
Saville-Kent, W. 1897. *The Naturalist in Australia.* Chapman and Hall, London.

A NEW SPECIES OF *MYRSIDEA* (MALLOPHAGA : INSECTA)

By THERESA CLAY, British Museum (Natural History), London

INTRODUCTION

One species of *Myrsidea* Waterston (Menoponidae) is known from the Malurinae (Muscicapidae), namely *M. pectinata* Clay, 1965 parasitic on *Malurus alboscapulatus* Meyer from New Guinea. The present species is represented by specimens parasitic on two species of *Malurus,* from Australia. This is part V of "Contributions Towards a Revision of *Myrsidea.*"

Myrsidea strangeri sp. n.

(Pl. I, figs. 1-4 ; text—figs. 1-4)

Type host : *Malurus splendens* Quoy & Gaimard.

This species is similar to *M. pectinata* from which it is distinguished by details of the abdominal chaetotaxy, especially the size of the single seta arising from the postero-lateral corner of sternite II (text-figs. 3-4), and by the characters of the male genital sclerite. In the following description those characters found throughout the genus and discussed in Clay, 1966 are omitted.

Male and Female. As shown in figures. This species resembles *pectinata* in the dorsal U- or V-shaped unpigmented area of the head; the number and position of the head setae and the reduction of the hypopharyngeal sclerites.

Thorax as described for *pectinata;* numbers of metanotal and metasternal setae fall within the range of those of *pectinata,* except that the female of *strangeri* has fewer central metanotal setae : 2-4 each side (excluding the long one at each end). Outer dorsal setae of first tibia : 4; number of setae in ventral brush on third femur falls within the range of those of *pectinata.*

Abdomen as in text-figs. 1-2. Male with more numerous tergal setae than *pectinata;* in the female the tergal setae are longer. In both sexes the single seta at each postero-lateral corner of sternite II is short (text-fig. 4). Anterior pleurites with stout flattened setae as in *pectinata* (Clay, 1965, fig. 4). Male genitalia similar to those of *pectinata* with the exception of the genital sclerite (Pl. I, fig. 4). The measurements of the small number of individuals available are similar to those of *pectinata* but may prove to average somewhat larger.

Material examined : 6♂, 5♀ from *Malurus splendens,* Dwellingup, W. Australia, 1968 (R. H. Stranger. 680414). 6♂, 2♀ from *Malurus cyaneus* Gmelin, Flinders Island, Tasmania, 21.iii.1966 (R. H. Green).

Holotype ♂ in the Division of the Entomology Museum, C.S.I.R.O., Canberra, Australia, from *Malurus splendens.* Paratypes : 5♂, 5♀ from the same host individual.

ACKNOWLEDGEMENTS

I am indebted to Mr. R. H. Stranger for the material from *Malurus splendens* and to Mr. J. H. Calaby for the material from *M. cyaneus* collected by Mr. R. H. Green; to Mr. Arthur Smith for the drawings and to the Photographic Studio of the British Museum (N.H.) for Pl. I, fig. 1.

REFERENCES

CLAY, T. 1965. Contributions towards a revision of *Myrsidea* Waterston II. *Proc. R. Ent. Soc. Lond.* (B), 34 : 117-122.

CLAY, T. 1966. Contributions towards a revision of *Myrsidea.* I. *Bull Br. Mus. Nat. Hist. Entom;* 17 : 327-395.